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ABSTRACT

Computer-assisted learning in numeracy for adults is far less developed than computer-assisted learning in literacy. Although a great many software programs exist, few are suitable for adults and many offer only drill and practice exercises instead of teaching genuine computer skills. One approach instructors can take is to have their students use content-free software, such as word processing, database management, and spreadsheet programs. With this approach, students develop computer skills at the same time they develop language, numeracy, or literacy skills; the computer program is never redundant; it is possible to develop new materials; existing materials can be modified; and once they have learned how to use the program, students have a powerful tool to use in other areas of their life. Instructors can learn the program with their students and should not let the fact that they are not expert in it deter them from using the program with students. Instructors can set up spreadsheets for basic number work, including exploring magic squares, discovering a relationship between two numbers, and investigating the powers of 10. In addition, they can use the spreadsheet program for its usual accounting exercises, such as working out personal budgets and comparing methods of payment. Word processing programs can be used to let students write about their experiences with math and answer on-screen worksheets that require mathematical thinking. The programming language LOGO can be helpful to adults, but they often are not interested in it. When students create a database with programs such as World Count, which has a high degree of numeracy content, the computer becomes an additional resource rather than the focus of attention. (CML)

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COMPUTER ASSISTED LEARNING IN NUMERACY

Freda Hollin, project worker on the ALBSU Special Development Project in Computer-Assisted Learning, outlines positive ways of incorporating CAL in numeracy work with adults.

Since computers were often introduced into education via mathematics departments we might be forgiven for expecting computer-assisted learning to be more developed in numeracy and maths than in other subjects. Unfortunately this is not so, and in the case of adult numeracy, which has always been the poor relation in Adult Basic Education, computer-assisted learning is far less developed that in literacy.

There are in fact a great many computer programs available for numeracy and maths, particularly for the BBC computer. However it is necessary to question their educational aims and methods, their suitability for adults, and to ask whether the numeracy skills involved might not be better developed in other ways.

Many of the programs available are of a "drill and practice" type. They encourage key-pressing but do not offer the student the opportunity to develop genuine computer skills. And if they are exercises that you wouldn't dream of asking students to do on paper, is it reasonable to expect them to be beneficial just because they're on the computer?

Moreover, some of the programs are less than helpful to students, for example programs which set out calculations involving larger numbers (say, long multiplication) in appropriate columns and then illogically expect the answer to be typed in from left to right, thus completely ignoring concepts of place value in performing the calculation.

Other programs are nothing more than text-books on screen, but less clearly presented and lacking the flexibility of use of a real text-book.

And many numeracy programs were written with children in mind, and it shows!

In choosing off-the-shelf programs it is also worth considering how much time a student can usefully spend using a program – in other words, is it good value for money?

So if the majority of dedicated numeracy programs are not to be recommended then what are we left with? Fortunately there are some exceptions (see Numerator and MicroSMILE boxes), and there are also other approaches to computer-assisted learning to be explored.

Another approach

Content-free programs turn computers into useful tools. Such programs enable the user to enter their own information; for example, a wordprocessor allows you to create, edit and manipulate text, and to store it and retrieve it again at a later date.

Using content-free software to develop students' skills has a number of advantages: the student is being offered the opportunity to acquire valuable computer skills at the same time as developing literacy, language or numeracy skills; the computer program used is never redundant as it is always possible to develop new materials to exploit it; existing materials can be easily modified for use with different students; and when they have learned how to use a program students have a powerful tool at their disposal for future work, which can encourage them to work more independently.

What often discourages tutors from using content-free software with their students is the time needed to learn how to use the program, and to prepare materials. However, it is always possible to learn how to use a program alongside the students, you don't need to be an expert. And any materials you produce can be used again and modified for different students so that you are building up a materials bank. If tutors can also get together to develop and swap materials then the burden is reduced and the benefits shared.

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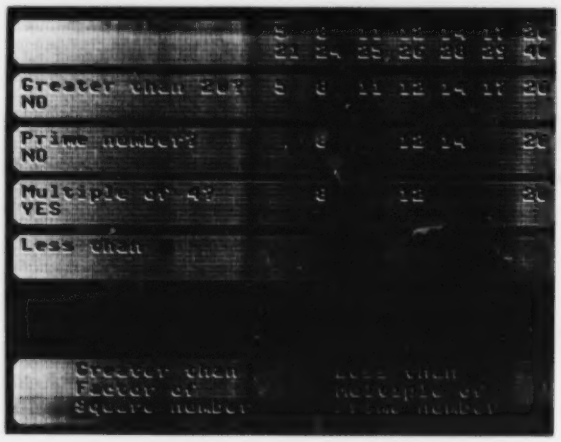
MicroSMILE



A screen from the program IDENTIFY from *The Next 17 MicroSMILE* pack. The computer produces a list of numbers at the top of the screen. One of them has been chosen as the computer's number which you have to identify by asking questions using the words given at the bottom of the screen.

The *MicroSMILE* computer programs were developed to complement the SMILE maths materials used in ILEA schools. There are three *MicroSMILE* packs - *the First 30, the Next 17,* and *11 More* - each containing a number of different programs (58 in total) accessed from a menu. The programs cover a wide range of topics including ordering numbers, understanding place value, fractions, angles and their measurement, symmetry, co-ordinates, to mention but a few.

Tutors need to guide the use of the programs if students are to gain the maximum benefit (and avoid the few programs which employ childish graphics). There is a temptation to choose a program at random from the menu, and without understanding the purpose of the program, quickly tire of it and move on to something else. The programs are better used either to introduce a topic, or to explore or consolidate work that is already being undertaken. In other words, dip into SMILE at the appropriate time.

A resource pack, *SMILE with a Micro,* which includes cards, worksheets, posters and boxed games, is now available to accompany nine of the programs from the first two *MicroSMILE* suites.

MicroSMILE programs for the Nimbus and BBC are available from the sales department at ILECC, John Ruskin Street, London SE5 0PQ. Each pack, *The First 31, The Next 17* and *11 More,* costs £20, a network licence costs £40. The *SMILE with a Micro* pack costs £14.

Numerator

Numerator is a relatively new program which can be described as a mathematical construction kit. It enables the user to build on screen "mathematical machines" or "number plumbing systems" to demonstrate and explore mathematical operations and relationships.

The program comes with demonstration "walkthroughs" supplied on disc which act both as a tutorial and a starting point for your own investigations.

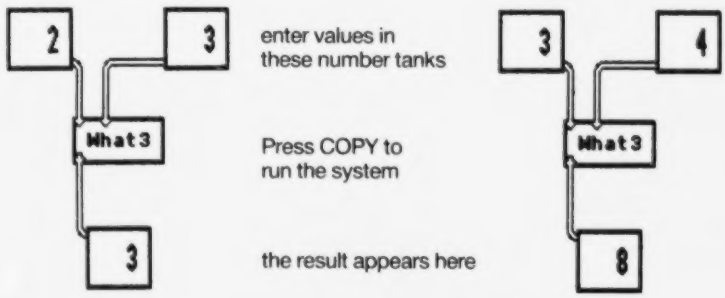
You can build very simple machines to add, subtract, multiply or divide numbers. You can then start the machine running and observe the process. You can build more complex machines incorporating simple ones, or using a range of mathematical operations. This makes *Numerator* a powerful program of use to students along a continuum of mathematical ability.

The problem for the tutor is in finding the time to understand the workings of the program, and to explore its potential for use with students. It should be possible to learn the basic functions alongside the students and from their comments and perceptions develop ideas for stimulating further investigations. It is debatable whether *Numerator* will be used to its full potential without the development of support materials.

For a more comprehensive review of *Numerator* see the November '89 issue of the OUTWRITE! newsletter available from the editor at ILECC, John Ruskin Street, London SE5 0PQ.

Numerator is available from Logotron, Dales Brewery, Gwydir Street, Cambridge CB1 2LJ.

Versions for the BBC B, B+ and Master cost £39; versions for RM Nimbus and Archimedes cost £69. LEA discounts available.

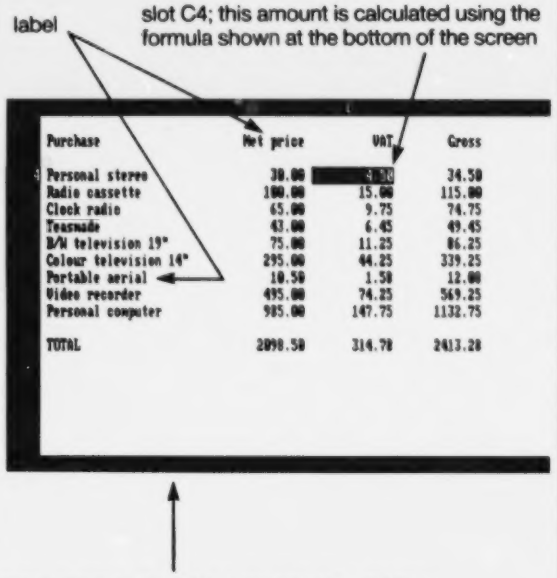


In this *Mystery Module* from a Walkthrough values must be entered in two number tanks at the top to produce a result in the bottom tank. By entering different numbers you can discover the process What3.

Spreadsheets

Spreadsheets are used in business and accounting. Although there are many different spreadsheet programs they all work in a similar way. The screen is divided into a grid of rows and columns, and each "slot" or "cell" has a reference (like a co-ordinate). Numbers can be entered into slots, formulae can be entered so that calculations can be performed (for example you can total a column of figures), and words can be entered so that rows or columns can be labelled. It is also possible, with some spreadsheet programs, to display the information in the form of bar charts and pie charts.

This sample spreadsheet was created using the Logistix program


label
slot C4; this amount is calculated using the formula shown at the bottom of the screen
Purchase
Net price
VAT
Gross
Personal stereo 30.00 4.50 34.50
Radio cassette 100.00 15.00 115.00
Clock radio 65.00 9.75 74.75
Teasmade 43.00 6.45 49.45
B/W television 19" 75.00 11.25 86.25
Colour television 14" 295.00 44.25 339.25
Portable aerial 10.50 1.50 12.00
Video recorder 495.00 74.25 569.25
Personal computer 985.00 147.75 1132.75
TOTAL 2098.50 314.70 2413.20
the number in slot C4 is calculated by dividing the number in B4 by 100 and then multiplying the answer by 15; this gives 15% of the number in B4
note: / means divide, *means multiply

Because spreadsheets are designed to store and manipulate numbers it is often assumed that they are the most appropriate tool for use with numeracy students. In fact initial excitement at the potential of a spreadsheet usually gives way to "Yes, but what do I do with it?"

It is possible to set up a spreadsheet for basic number work, for example exploring magic squares, or discovering a relationship between two numbers in different slots by changing one of the numbers and observing the resulting change in the other, or for investigating multiplication by powers of 10, etc. This sort of exercise can be useful for introducing students to a spreadsheet, but the numeracy involved certainly doesn't require a sophisticated program – although it might be more fun, and motivate the student, which is ample justification.

Spreadsheets can be used for a whole range of accounting exercises such as working out personal or household budgets, comparing methods of hire purchase repayments or calculating wages. They can also lend themselves to work-related numeracy, for example, comparing costs for a painting and decorating job using different materials. The tutor can prepare a spreadsheet which the student can then compete, thus introducing the student to a wider range of spreadsheet facilities.

But students are going to be stretched much more when they can reach the stage of setting up their own spreadsheets for a particular purpose. They will then be involved in planning the spreadsheet and working out the necessary formulae for the calculations which need to be performed. The process of creating a spreadsheet demands that students think through the mathematical processes involved in setting out and solving a problem.

Wordprocessing

The wordprocessor is well-established as a tool for developing literacy and language skills. However, it is also worth considering how it might be used by numeracy students, particularly for those students who are already familiar with a wordprocessor.

Numeracy students often benefit from the opportunity to explore their experiences of learning maths, and perhaps following some discussion, this can be done successfully using a wordprocessor. Experiences are likely to include descriptions of school and teachers, and the sort of things they learned at school, but most importantly the students' feelings about the experiences. This can produce comments like, "I was good at Maths until we did fractions", "we used to get hit over the head if we got the answer wrong", "the teacher only took any notice of the boys", and so on. Be warned of the anger you may release if you embark on this with your students, but it can be very rewarding in terms of uncovering sources of students' anxiety about maths.

Another approach to using the wordprocessor is to follow the lead established in literacy practice. That is, to introduce wordprocessing skills systematically through the use of prepared exercises. In literacy classes these exercises will focus on language skills, but they could equally well be numeracy exercises. The new Nimbus/IBM version of *Wordprocessing for Literacy Skills*[1], by Lynette Oliphant, contains a number of exercises which are numeracy-based, such as answering questions about a given list of temperatures around the world, or questions about a timetable. These examples provide good models for tutors to develop their own numeracy exercises on whatever topic is of interest or use to their students. This use of the wordprocessor is the same as offering the student written worksheets, but of course they are also developing wordprocessing skills. This approach can work well for tutors who seek to integrate numeracy and literacy teaching.

LOGO

LOGO is a programming language (strictly speaking, a philosophy of education in a family of computer languages) although it is best known for "turtle graphics".

The turtle is a small triangle on screen (unless you are lucky enough to afford a more realistic looking floor turtle). The turtle can be moved around by typing in commands at the keyboard, and leaves behind a line tracing out its path. The turtle can move forwards or backwards, and can turn left or right through a specified number of degrees.

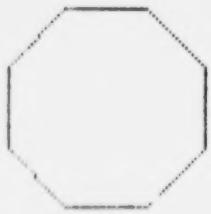
The philosophy behind LOGO was to enable the user to teach the computer rather than being taught by it. This philosophy is described by Seymour Papert in his book *Mindstorms*[2]. On Turtle Geometry he says, "Since learning to control the turtle is like learning to speak a language it mobilizes the child's expertise and pleasure in speaking. Since it is like being in command, it mobilizes the child's expertise and pleasure in commanding. To make the turtle trace a square you walk in a square yourself and describe what you are doing in TURTLE TALK. And so, working with the turtle mobilizes the child's expertise and pleasure in motion. It draws on the child's well-established knowledge of "body geometry" as a starting point for the development of bridges into formal geometry".

This approach has worked well in primary education where children have followed their own inclination to draw pictures and patterns and in the problem-solving process have developed their mathematical knowledge and abilities.

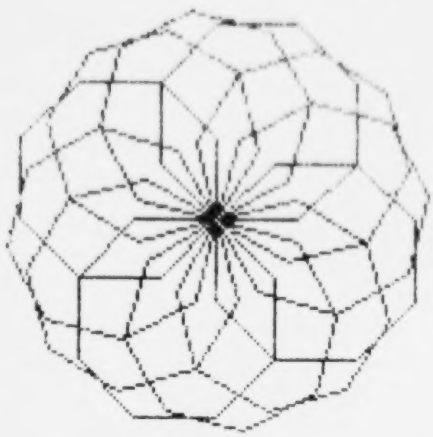
LOGO

Generating a pattern by drawing octagons, turning the turtle through 30 between each one. The commands for drawing a line, an octagon and the pattern are given.

FORWARD 25 LEFT 45



```
TO OCTAGON
REPEAT 8
[FORWARD 25 LEFT 45]
END
OCTAGON
```



```
TO PATTERN
REPEAT 12
[OCTAGON LEFT 30]
END
PATTERN
```

Encouraging adults to explore LOGO can present problems. Many adults have never been encouraged to investigate and explore and will find it difficult to get started without some direction from the tutor. They are also more likely to be inhibited about getting up and "playing turtle" themselves in order to solve a problem. They are less likely to want to draw pictures, although many are interested in geometric shapes and patterns. And adults are also more likely to question the relevance of LOGO, or the importance of geometry, and indeed this might well be true if their aim is to become a postman!

Nevertheless LOGO has much to offer to many students, and does involve considerable number work in making calculations to solve a particular problem. If you can encourage those who are interested they are likely to present you with ideas for stimulating other students. Materials for using LOGO can be developed as you go along and some students might well be motivated to produce materials and tasks for others.

Databases

A database program enables you to store, manipulate and retrieve information. We all have experience of databases, directly or indirectly, and a discussion with students will elicit ideas about what information is kept, by whom and for what purpose – for example, police records, vehicle registration, the electoral register, and so on. It is worth pointing out too that cashpoints and electronic checkouts at supermarkets are forms of database.

You will need a ready-made database to introduce students to the concepts. Every database program will enable you to search for a particular piece of information, and to sort all the information either alphabetically or numerically. Beyond that, different programs offer different facilities; some will calculate the average in a particular field, or offer other statistical analyses, and some will offer graphic displays such as pie-charts or line graphs. The *World Count*[3] pack, written for adults, is an example of a ready-made database with a strong numeracy content.

When students are familiar with the database program they can be encouraged to create a database themselves. This is likely to be a group activity which will take place over several weeks.

It is important to choose a subject of interest to the students, and to consider how the final database might be used. For example a recipe database containing information about the cost of a dish, the calorific , fat and sugar content, and the time taken to prepare and cook, could be used in planning meals. A database on housing, using official housing statistics, could lead to a comparison of homelessness in different cities, or the proportion of home-ownership, etc. This sort of project could involve a variety of related non-computer tasks, including finding and marking places on a map, drawing charts to display the findings, collecting relevant newspaper articles and writing about the issues, as well as promoting a lot of discussion.

Creating a database as part of a project allows the computer to become an additional resource rather than the focus of attention, and both numeracy and computer skills become integrated into a broader curriculum.

Which software?

There is a wide choice of content-free programs available for most computers. Even if you have access to sophisticated commercial software it is important to consider whether it would be better to use educational versions instead as these will usually be adequate for your needs and will probably be much easier to use. If your aim is to develop numeracy skills, then you don't want to get bogged down in how to operate the software!

Conclusion

The lack of good dedicated numeracy programs should not be seen as a problem in the development of computer-assisted learning in numeracy. You are likely to offer your students a more creative experience, and involve them more in determining the direction of their learning, by introducing them to the few packages outlined here. In addition, both you and your students can benefit from working together to build up gradually a bank of appropriate materials which can be used again and again.

1. The IBM/Nimbus version of *Wordprocessing for Literacy Skills*, by Lynette Oliphant, for use with Microsoft Word, to be published by ILECC for ALBSU.
2. *Mindstorms – Children, Computers and Powerful Ideas* by Seymour Papert, published by The Harvester Press, price £7.95.
3. *World Count*, published by ILECC for ALBSU, is available from ILECC, John Ruskin Street, London SE5 0PQ, price £18.00.

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